Determinants of Economic Growth in Sub-Saharan Africa: The case of Ghana

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25. September 2015

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Abstract

This paper assesses the determinants of economic growth in Ghana during the period 1970-2012 by making use of the Bayesian Model Averaging (BMA) in order to address the issue of model uncertainty. Making use of the Markov Chain Monte Carlo Model composition $(MC)^3$ for model selections, the results of the empirical analysis show the importance of variables such as current account balance, inflation rate and population growth as well as the role of the dual economy in driving economic growth in Ghana. These results show that economic growth policy in Ghana should not be confined within a specific growth theory, be it neoclassical and Keynesian. The results are robust with the change of model priors in the context of the BMA analysis.

JEL **Codes**: E01, E10
Keywords: Ghana, Growth, Model uncertainty, Bayesian model averaging

1. Introduction

A number of African governments have adopted aggressive macroeconomic policies in order to trigger the level of economic growth that should eventually alleviate rampant poverty and reduce income inequality. It is in this context that the South African government, for example, adopted the GEAR (Growth, Employment and Redistribution) macroeconomic policy in 1996 in order to accelerate economic growth and employment as well as address the problem of income inequality in the country. However, many observers, including the trade unions and academics, have raised various concerns about the effectiveness of the GEAR policy. For example, Terreblanche (2002) questions the South African government's ability to attain the objectives of income redistribution and poverty alleviation through the GEAR policy. The author's anxiety is related to the fiscal discipline approach pursued by the GEAR policy to reduce the conventional budget deficit below the level of 3% of the GDP, a move, according to Terreblanche, that would result in the reduction of expenditure allocated to social services. Moreover, Cosatu (1997) accuses the South African government of blindly pursuing neoclassical or neoliberal growth policy, which is redundant for African countries. Cosatu remarks that the neoliberal approach to economic growth, with its fixated focus on fiscal discipline, cannot be appropriate for African countries, as this approach fits only countries that have reached an advanced stage of development.

Moreover, a number of policy prescriptions for economic growth enforced on developing countries by the Washington Consensus have been fiercely criticised, as their expected outcomes have not been achieved. One of these policy prescriptions is the Structural Adjustment Programme (SAP) introduced by the International Monetary fund (IMF) and the World Bank. For example, Ibhawoh (1999) remarks that the reason for the failure of the SAP is its heavily reliance on neoliberal economic growth principles. The author indicates that the SAP did not take cognisance of the particularities of developing economies. It is important to note that the key policies of the SAP included the liberalisation of the economy, the elimination of exchange controls, the reduction of public expenditure to alleviate budget deficit and privatisation of domestic industries (Garuda, 2000). Adedeji (1999) shows that the SAP failed to achieve its aim of promoting economic growth and alleviating poverty in Africa because the neoliberal policy stance adopted by the programme was not attuned to African economic realities. Furthermore, Adedeji (1999) remarks that the IMF and World Bank neglected to recognise that African economies are at different stages of development,

compared to developed economies, such as the United States (US) and United Kingdom(UK), and imposing a 'one size fits all' policy on developing countries was the biggest mistake of the Washington Consensus institutions.

In explaining why the SAP failed in Africa, Briggs and Yeboah (2001) remark that African economic realities are different to most of the developed economies, and these realities need to be taken into account for any policy prescriptions that aim at sustainable economic growth. For example, the vast majority of African economies depend on primary commodities as their main source of revenue generation. This is more pronounced in a number of sub-Saharan African (SSA) countries that rely on a single agricultural commodity for their merchandise export revenues (World Bank, 2011). However, Deaton (1992) shows that because these commodities are price-inelastic, export expansion as a result of free trade policy, as supported by the SAP, can have a negative effect on their export revenue generation. This reality raises concerns about whether trade liberalisation policy, as pioneered by the SAP, is growth-enhancing for African economies.

Contrary to the neoclassical policy prescription, there is some empirical evidence that supports the failure of trade liberalisation to enhance socio-economic welfare in developing economies. For example, Hur and Park (2012) find that trade liberalisation has had little impact on economic growth in a number of sub-Saharan African countries. Moreover, Baunsgaard and Keen (2005) show that the negative impact of trade liberalisation on economic growth is due to the fact that most developing countries derived their tax revenues from custom duties. Thus, preventing these countries from this important source of revenues is detrimental to their ability to raise the needed funds for capital expenditure.

Another particularity of African countries that has had a considerable impact on their economic growth is their political situation. Unfortunately, the neoclassical growth model has failed to account for the importance of political instability for economic growth until the influential empirical work of Barro (1991) and Barro and Sala-i-Martin (1992, 1995). The key points of neoclassical policy prescriptions have focused more on economic and financial variables, with very little attention being paid to non-economic variables (Ibhawoh, 1999).

An adequate understanding of the determinants of economic growth in Africa requires proper consideration of its dual economy. Vollrath (2009) shows that contrary to the neoclassical growth theory that focuses primary on one-sector models, most developing countries are characterised by the dual economy – integrating the elements of the modern commercial sector with the traditional subsistence sector. The modern commercial sector is mostly founded on market economy principles characterised by privatisation and liberalisation. The traditional subsistence sector is geared to the traditional cropping system to serve the subsistence economy. The allocation of resources to this sector is not based primarily on the neoclassical principle of optimisation (Matsuyama, 1992; Galor and Mountford, 2008) . Blunch and Verner (1999) indicate that the interaction between the two sectors is necessarily for the acceleration of economic growth and poverty alleviation in sub-Saharan countries. While the modern commercial sector is an important source for export revenues generation, the traditional subsistence sector plays an important role in poverty alleviation and allocation of resources.

From this background, it is clear that focusing on a specific or single growth model, be it neoclassical or any other single growth model, in order to identify the drivers of economic growth in African economies may be misleading and misinforming. The reasons why a single growth model should be inappropriate in identifying the determinants of growth in Africa are twofold: firstly, the particularity of African countries, and especially the existence of a dual economy in Africa, necessitates a combination of different single growth models in identifying the drivers of their economic growth. For example, Africa needs active government participation in order to build proper infrastructure to attract private investment. By contrast, liberalisation and privatisation are conditioned by a number of funding institutions to finance the increasing socio-economic needs of African countries. Secondly, single growth theories or models rely on limited variables to explain economic growth. This limitation is often justified by the limitation of a number of econometric techniques to deal with many explanatory variables due to the issue of the degree of freedom and standard error in model estimation. Thus, single growth models that derive their foundation from schools of economic thought, such as the different variants of neoclassical and Keynesian schools of thought (see Solow, 1956; Harrod (1939); Domar, (1946); Barro and Sala-i-Martin (1995) and Easterly and Rebelo (1993)) might not be appropriate to identify the determinants of economic growth in sub-Saharan African economies.

To remedy to these challenges, this paper makes use of the Bayesian Model Averaging (BMA) approach, a modelling approach that deals with the issue of model uncertainty (see Raftery et al., 1997). The paper applies this approach to identify the determinants of economic growth in Ghana, as a case study of a fast-growing Sub-Saharan African economies. Ghana was chosen for two reasons: firstly, Ghana is among the fastest-growing economies in Africa, with a GDP growth averaging 5% in the last decade. Secondly, Ghana is the first African country to consistently pursue the SAP, albeit with mixed results (Anaman, 2006).

To the best of our knowledge, there is no study that identifies the drivers of economic growth in Ghana by using the BMA approach. Furthermore, a number of studies that made use of the BMA approach to determine the drivers of economic growth did not explicitly address the issue of multicollinearity and cointegration that may arise with the use of many explanatory variables. A number of studies that made use of the BMA approach also used cross-sectional data to avoid accounting for the possible existence of multicollinearity and/or cointegration of variables. For example, Masanjala and Papageorgiou (2008) use the BMA approach to identify the determinants of economic growth in Africa. The authors make use of a cross-section of average values measured over the period 1960 to 1992 and find that mining, primary exports and initial primary education have a considerable impact on African's economic growth. Moreover, Fernandez et al. (2001) use a cross-section of data from 72 countries and 41 potential explanatory variables in order to identify the determinants of economic growth in the period 1960 to 1992.

The contribution of this paper is threefold: firstly, the BMA approach is applied in the case of Ghana, a representative sample of a fat-growing SSA country, whereby the potential drivers of economic growth are selected by taking into account the particularity of SSA economies during the period 1970 to 2012. Contrary to the previous studies in Africa, this period corresponds to a number of policy interventions in Africa, such as the SAP and the democratisation of a number of African states. Secondly, the BMA approach is applied to time series data rather than cross-sectional data. Consequently, the empirical analysis addresses the issues of multicollinearity and stationarity in the selection of explanatory variables to be included in the model. Lastly, the robustness and the consistency of the posterior results are addressed by using different model and coefficient priors.

The rest of the paper is structured as follows: section 2 briefly discusses the trend of economic growth in Ghana. Section 3 presents the empirical model used in the paper. Section 4 presents the data and discusses the empirical results. Finally, section 5 presents the conclusion and policy recommendations.

2. Trends in economic growth in Ghana

The growth record of Ghana has fluctuated from its independence to the present. In the early 1950s to the mid-1960s, the economy of Ghana experienced relatively high GDP growth. On average, the GDP growth was about 8% (World Bank, 2012). This relatively high GDP was due to the excess reserve the country inherited from its colonial masters and the import substitution industrialisation policy which saw the establishment of industries in the country. From 1964 to 1984, the Ghana's economy experienced economic turbulence, which saw economic growth to slow down. From the economic growth pattern of Ghana shown in Figure 1, during the periods 1966, 1972, 1975-1976, 1979, and 1983, the growth rate of real GDP was negative. This was because between 1966 and 1981 the country underwent continuous periods of political instability. In addition, the year 1982 and 1983 were characterised by many attempted coups and a major drought, which was marked by low levels of investment. In 1970, the GDP growth rate of the Ghanaian economy reached its peak at 10%; unfortunately this record level of growth was not sustained, following the February 1972 coup headed by General Acheampong. By 1975, the growth rates had hit the lowest rates of -12.43%. Growth remained poor and negative in most years from 1972 until the reform period in the mid-1980s.

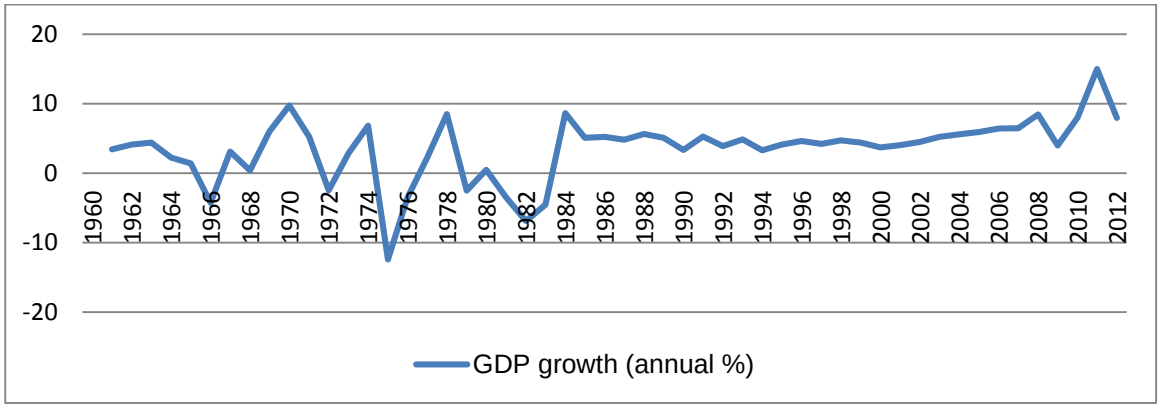

Figure 1: Trends in economic growth in Ghana

From Figure 1 it can be observed that the growth rate remained highly volatile for the period 1980-1989, with a mean annual growth rate of 1.99%. However, it stabilised around an annual growth rate of 5.5% from 1986 to 2012, which was as a result of the adoption of the International Monetary Fund's and World Bank's Structural Adjustment Programme policies which sought to liberalise the economy and increase investment. Between 2005 and 2007, the economy grew at an average of 5.5%, and this was largely attributed to the power rationing and energy shortages resulting from the low water level in the Akosombo Dam (Andaman, 2006). The average GDP growth from 2008 to 2012 was 8%. In 2011, the economy grew at the rate of 15%, an exceptional growth rate in the history of Ghana. This was attributed to the rise in business confidence triggered by offshore oil exploitation that started in 2010. However, this growth trend was not sustained and GDP fell to 7.1% in 2012.

3. **Empirical Model**

The rationale for the BMA approach is that for a given linear model with a large number of explanatory variables, k, there are 2^k possible models which can be obtained by the selection of explanatory variables. Appropriate models with the high likelihood function are obtained by averaging across large set of models and selecting variables which are relevant to the data generating process for a given set of parameter and model priors used (Raftery et al., 1997; Fernandez et al., 2001). Parameter and model samplings in the context of the BMA approach are conducted with the aid of Markov Chain Monte Carlo Model composition (MC^3). The MC^3 method is used to indicate which model should be considered in computing the sums of posterior model and parameter probabilities by identifying the model with high posterior probability.

Given a linear regression model with β_i parameters and $i=0,1,2,...,k$. With y as GDP per capita and k explanatory variables $x_1, x_2, x_3, ..., x_k$, the general form of the regression is

$$y=\beta 0+\sum_{i=1}^{k}\beta_i x_i +\varepsilon \qquad (1)$$

Given k explanatory variables, there is a possibility of 2^k models being obtained, with a different combination of explanatory variables. The posterior distribution of the parameters β_i, given the data, D, is an average of the posterior distribution of parameters under each model with weights given by the posterior model probabilities and expressed as

$$P(\beta_i / D) = \sum_{j=1, \beta_i \in Mj}^{2^k} P(\beta_i / M_j) P(M_j / D) \quad (2)$$

and posterior model probability, $P(M_j / D)$ is given by

$$P(M_j / D) = \frac{l_D(M_j) P(M_j)}{\sum_{h=1}^{2^k} l_D(M_h) P(M_h)} \quad (3)$$

Where $l_D(M_j)$ is the marginal likelihood of the model M_j which is expressed as

$$l_D(M_j) = \int p(D / \beta_i, M_j) p(\beta_i) p(\beta_i / M_j) d\beta_i \quad (4)$$

Where $P(D / \beta_i, M_j)$ represents the sampling model corresponding to Equation 1. $P(\beta_i / M_j)$ is a prior probability distribution assigned to the parameters of model M_j, and $P(\beta_i)$ is the improper non-informative prior for the parameters that are common to all models.

With regard to model probability prior $P(M_j)$, the proposed prior distribution in the literature of BMA refers to the uniform distribution prior expressed as

$$P(M_j) = p_j, \quad j = 1, 2.., 2^k \text{ with } \sum_{j=1}^{2^k} p_j = 1 \quad (5)$$

Fernàndez et al., (2001) propose the use of improper non-informative priors for the parameters that are common to all models, such as β_0 in Equation 1, and Zellner's g-prior for the regression parameters β_i. This is denoted as

$$P(\beta_0) = 1 \quad (6)$$

and $\beta_i / h \sim N(0, h^{-1}[g_i X_i^{'} X_i]^{-1})$ (7)

where h^{-1} is the variance of ε, X represent the explanatory variables and g_i is the scalar hyperparameter from the Zellner's g-prior (see Zellner's, 1986).

It should be acknowledged that the choice of priors can have substantial effects on the parameter and model posteriors in the context of model uncertainty. It is for this reason that this paper compares the effects of two different model priors on the BMA results as part of the robustness test.

Following Leamer (1978), the estimated posterior means and standard deviations of βi are constructed as

$$E(\beta_i / D) = \sum_{j=1}^{2^k} \beta_i P(M_j / D) \quad (8)$$

$$V(\beta_i / D) = \sum_{j=1}^{2^k} (Var(\beta_i / D, Mj) + \beta_i^{\ 2}) P(M_j / D) - E(B_i / D)^2 \quad (9)$$

Contrary to the MCMC that is used to draw posterior parameters or coefficients in the Bayesian modelling, the MC^3algorithm allows for the computation of posterior model probability by drawing from model space. The MC^3 is based on the Metropolis-Hasting algorithm, as it simulates a chain of models from which candidate models are drawn from a particular distribution over model space (Fernàndez et al., 2001).

3. Data, empirical results and discussion

Table A1 in the appendix presents variables assumed to be candidate explanatory variables of economic growth in Ghana. Yearly data ranging from 1970 to 2012 was collected from the World Bank Development Indicators (WDI, 2012) and International Monetary Fund (IMF) statistics. There are 22 variables used in the model estimation, including the GDP per capita as the dependent variable. Explanatory variables are selected by taking into account their likelihood of determining economic growth in Ghana. Moreover, these variables are selected by accounting for the particularities of the Ghanaian economies, such as the existence of the dual economy and its reliance on natural resources for export revenues. The explanatory variables include: the current account balance per GDP, inflation, market capitalisation of listed companies per GDP, public spending on education per GDP, annual population growth, progression to secondary education as a proxy for human capital growth, total natural resources rent as a percentage of GDP, total crop production per GDP, population density, capital formation per GDP, broad money growth, total domestic debt stock of the economy per GDP, total external debt stock of the economy per GDP, taxes of profit, merchandise trade percent of GDP, life expectancy, custom tax rates, labour force participation rate and total number of telephone lines per 100 people as a proxy for infrastructural development in Ghana. Current account balance captures the contribution of the main export revenues of Ghana, which are gold, cocoa beans and timber products. Gold is the biggest export earner for Ghana,

contributing 48% of the export revenue of the country in 2010 (World Bank, 2011). Crop production indicates the importance of the primary agriculture production that is used for commercial and subsistence purposes.

Table A2 in the appendix presents the correlation matrix of the explanatory variables in order to detect possible multicollinearity problem in the BMA estimation. The cross-correlation values reported in Table A2 reveal the absence of perfect collinearity[1], thus excluding the possibility of discarding some explanatory variables. Table A3 presents the descriptive statistics of the variables used in the paper. The result shows that on average from 1970 to 2012, the average GDP growth was 1.1% (0.0011), with a minimum of -10% and a maximum of 14%. In addition, the average public expenditure on education as a percentage of GDP was about 2.89 %, with the lowest being 0.64% and the maximum percent spend on education being 12.2%.

To ascertain that all variables are stationary and that there is no possibility of cointegration between them, the paper applies the Dickey–Fuller Generalised Least Square (DF-GLS) test of unit root as proposed by Elliott, Rothenberg, and Stock (1996). The authors have shown that this test has significantly greater power than the previous versions of the augmented Dickey–Fuller (ADF) test. The results reported in Table A4 show that all variables are stationary.

The results of the BMA analysis reported in Table 1 are obtained with the model prior set to $1/2^k$, where $k=21$ is the number of explanatory variables included in the model. The prior probabilities of the regression coefficients are obtained as in Equation 7 by assuming that the coefficients of the explanatory variables are distributed with mean zero and the variance that follows the Zellner's g-prior structures. Moreover, the MC^3 sampling employed are based on taking 1000 000 draws, from which 100 000 draws are discarded as burn-ins replications in order to obtain model and coefficient posteriors. Table 1 presents the posterior inclusion probability and the posterior mean, as well as the posterior standard deviation for each explanatory variable. We follow Raftery (1995) by suggesting that for a variable to be considered as an effective driver of economic growth its posterior inclusion probability must exceed 50%. This criterion is equivalent to a ratio of the posterior mean to the posterior standard deviation of being close to unit in absolute value. On the basis of this

[1] The criteria followed was to exclude one the variables where the cross-correlation was unity.

criterion, the following regressors are identified as the main drivers of economic growth in Ghana to a higher extent:

- The rate of labour force (lfr).
- Population density (Popden).
- Number of telephone per population (Tel) as the proxy of infrastructure development.
- Inflation rate (inf).
- Total agriculture production per GDP (Cpd).
- The current account balance (Cacc).

Table 1 Bayesian model averaging results

Explanatory variables	Posterior Inclusion Probability	Posterior Mean	Posterior Standard Deviation
Pse	30.6	-0.006.43	0.0114
Inf	99.2	-0.008.20	0.00263
Lfr	100	-0.0211	0.00436
Bm	2.7	-0.00000852	0.0000884
Pol	1	-0.000501	0.00563
Pss	8.1	0.000202	0.00105
Popden	100	0.0159	0.00627
Tel	63.7	0.0419	0.0392
CuTax	7.2	0.000231	0.000118
Pta	2.8	-0.000117	0.00115
Cpd	91.4	0.00788	0.00393
Mcap	2.7	0.0000177	0.000190
Dcp	1.2	0.0000278	0.000450
Ficap	13.5	0.000300	0.00100
Le	15.7	-0.00332	0.00977
Edebt	27.5	-0.000393	0.000788
Ddebt	1.1	-0.00101	0.0219
Mtrade	4.9	0.0000221	0.000147
Cacc	99	0.227	0.0906
nNtres	1.1	0.0000361	0.000651
Exgdp	41.4	0.00142	0.00220

Source: Authors' estimate

The coefficients posterior mean of these regressors show the negative influence of inflation and labour participation rates in Ghana. As for the negative relationship between inflation and economic

growth, there is a great deal of evidence that inflation depresses economic growth in Africa and in many developed and developing economies (Clark, 1997; Bittencourt et al., 2014). A high level of labour participation rate is found to hamper economic growth in Ghana. This reality is commensurate with the fact that the public sector remains the single most important source of employment for job-seekers in Africa, in general, and Ghana, in particular (World Bank, 2008). In a situation not particular to Africa or Ghana, the poor development of the private sector forces government to absorb job-seekers, sometimes for political reasons, thereby causing a diminishing marginal return to labour.

The posterior coefficient estimates indicate the positive relationship between economic growth and the current account balance in Ghana. Ghana's current account is boosted by the exportation of mining resources such as gold, contributing 29% of total exports in 2012, and primary agriculture products, such as cocoa beans, contributing 18% of total exports in 2012 (World Bank, 2013). The importance of mining and primary exports to the economic growth of African economies is consistent with the results of Masanjala and Papageorgiou (2008). Moreover, the importance of the dual economy in Africa, especially the role of primary agriculture production, which serves the subsistence economy, is indicated by the positive relationship between crop production and economic growth in Ghana. While the neoclassical growth theory downplays and dismisses the role of the subsistence economy, Kuokkanen (2011) shows that the subsistence economy can lead to economic growth and development by increasing household production. Moreover, Gutema and Fayissa (2004) show that subsistence economies contribute to economic growth by promoting positive externalities and discouraging negative externalities. It can be argued that subsistence economies can promote positive externalities in many ways; firstly, the increase in crop production will mean lower importations of consumption goods and will contribute to a sound current account balance. This situation implies that attention is paid to importing capital rather than consumption goods. Secondly, the increase in total crop production helps to stabilise general price levels, leading to low inflation. This in turn will boost investor confident levels and, thus, economic growth. This finding is in conformity with Rask and Rask (2011), who found a positive link between food production, which is the main activity of subsistence economies, and economic development in developing economies.

The increase in population density, informed by the increase in population growth, constitutes an important source for the aggregate demand in Ghana. Moreover, population growth spurs the growth of human capital and, thus, economic growth in Ghana. A number of studies have shown that the level of human capital has grown in African countries and worldwide and has subsequently become an important driver of economic growth in these countries (Bittencourt et al, 2014; Galor and Weil, 2000).

Table 2: Posterior means of the best five models

	Model 1	Model 2	Model 3	Model 4	Model 5
Pse				-0.02192*	.
Inf	-0.0103*	-0.00935*	-0.0097*	-0.006573*	-0.00651*
Lfr	-0.0241*	-0.02398*	-0.0230*	-0.01776*	-0.0185*
Bm					
Pol					
Pss					
Popden	0.0106*	0.0136*	0.0133*	0.02142*	0.0183*
Tel	0.0785*	0.0582*	0.0688*		
CuTax					
Pta					
Cpd	0.0111*	0.00959*	0.00945*	0.004633*	0.00608*
Mcap					
Dcp					
Ficap			0.00230*		
Le					-0.0258*
Edebt				-0.001593*	
Ddebt					
Mtrade					
Cacc	0.160*	0.216*	0.215*	0.2927*	0.188*
nNtres					
Exgdp		0.00144*		0.004585*	
R^2	0.957	0.959	0.959	0.962	0.955
Post. Probability	0.131	0.068	0.067	0.060	0.047

* indicates 1% level of significance

In order to gain insight into the degree of uncertainty that single models estimation could provide when assessing the determinants of economic growth in Ghana, the results reported in Table

2 are compared with those in Table 1. Table 2 provides the results of the first five best single models, classified by the magnitude of the model posterior probability calculated from models visited by the MC^3 algorithm. The results reported in Table 2 indicate how misleading could be any policy formulation that relies on the single-model estimation could be. For example, Model 4, in Table 2, indicates the importance of explanatory variables such as inflation rate, labour participation rate, population density, telephone number per total population, crop production, external debt per GDP and current account balance. Nonetheless, this model has the posterior model probability of 0.060 (6%), which means that policymakers who base their recommendation on the basis on the estimation of this model will be more than 94% sure it is not the correct model.

Figure 2 displays graphs of the posterior distribution of the coefficients obtained from the BMA estimation, as reported in Table 1. The posterior probability that a specific regressor has a coefficient equals to zero is represented by a solid vertical line at zero on the horizontal axis. The height of the solid line shows the probability that the coefficient is zero. For example, there is a probability of 35% that the coefficient of the regressor 'TEL' (the number of telephone per total population) is zero in explaining economic growth in Ghana. From Figure 2, it can be confirmed that variables such as population density, labour participation rate and current account balance are the important determinants of economic growth in Ghana, given the magnitude of the non-zero posterior probability of their regression coefficients.

To test the robustness of our results, we re-estimated the BMA model by using the binomial model prior, in addition to the uniform model prior used previously. The binomial model probability implies the probability of 50% (probability of success) for a given model to be drawn with the MC^3 sampling process. Using the 50% threshold of the posterior inclusion probability, the results reported in Table 3 indicate the importance of variables such as the labour participation rate, inflation rate, population density, crop production and current account in explaining economic growth in Ghana. These results are consistent with those obtained when using the uniform model prior, with the exception of the PIP of the regressor 'TEL', which is now 42%. The threshold of 42% can arguably be accepted by policymakers for the selection of relevant variables. This finding gives an assurance that our results are robust and consistent with the change of coefficient priors.

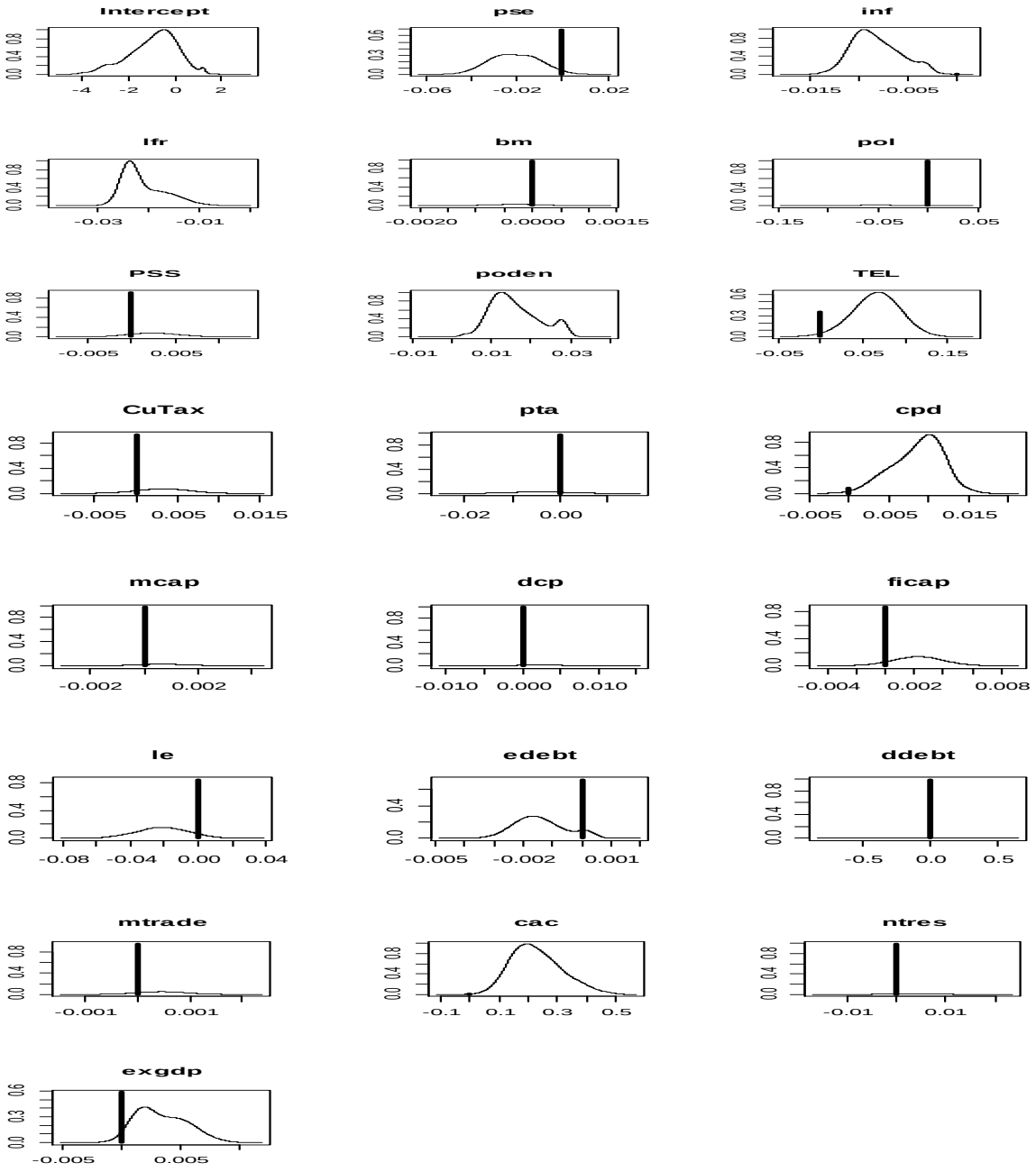

Figure 2 Posterior distributions of coefficients

Table 3: BMA results for robustness test

	PIP	Post Mean	Post SD
Lfr	0.9925	-0.0196	0.006217624
inf	0.9635	-0.00773	0.004030646
Popden	0.9065	0.0148	0.008897581
Cpd	0.835	0.00779	0.005719162
Cacc	0.751	0.179	0.143728691
Le	0.4725	-0.0121	0.01969393
Tel	0.42	0.0301	0.043854553
Pss	0.2445	0.000881	0.002330662
Pse	0.238	-0.00389	0.009451642
Exgdp	0.2345	0.000283	0.001452577
Pol	0.212	-0.00598	0.027856093
Ficap	0.2075	0.000494	0.001469073
Edebt	0.1825	-0.00009	0.000440148
Ddebt	0.1765	-0.0093	0.13348839
CuTax	0.174	0.000282	0.001914949
Pta	0.151	0.000335	0.004611473
Mtrade	0.1235	0.0000722	0.000390516
ntres	0.1185	0.000341	0.002674698
Bm	0.1075	-0.000034	0.000207806
Dcp	0.102	-0.0000107	0.001760616
Mcap	0.074	0.0000167	0.000366211

4. Conclusion and policy recommendations

This paper aimed to determine the drivers of economic growth in order to guide policymakers in Ghana in their pursuit of a sustainable growth policy. Faced with the issue of model uncertainty that arises due to the shortcoming of single growth models of including many variables in their specifications, the paper makes use of the BMA approach. With the BMA approach, the selection of important explanatory variables for economic growth in Ghana is dealt with by averaging across a large set of models. This is achieved through the Markov Chain Monte Carlo Model composition (MC^3). Using the 50% threshold, as suggested by Raftery (1995), for the selection of relevant variables that drive economic growth in Ghana, the empirical results show that variables such as population density, crop production, inflation rate, labour force, current account balance and population growth are the important drivers of economic growth in Ghana. The paper draws the following conclusions in the light of these results. Firstly, given the negative impact inflation rate has on economic growth in Ghana, the paper suggests that the anchor of monetary policy should remain

controlling inflation. It also acknowledges the importance of inflation targeting in Ghana. Secondly, the negative impact of labour force participation on economic growth, indicating the diminishing marginal return of labour in Ghana, due to the fact that the public sector remains the single most important source of employment for job-seekers in Ghana. we recommend that the government of Ghana develops policies and strategies that enable the crowding-in of the private sector. Finally, the importance of the dual economy, with the contribution of crop production in the commercial and subsistence sectors, must not be dismissed as could be the case if Ghana chooses to rely blindly on neoclassical policy prescriptions.

The paper shows that the results of the BMA analysis are robust with the changes in model priors. Moreover, the paper suggests that the identified explanatory variables for economic growth be dubbed covariates rather than determinants of economic growth due to the possible endogeneity problem that may arise. Further research could involve investigating the problem of endogeneity by making use of the two-stage least squares in the context of the BMA approach.

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APPENDICES

Table A1 codes and full name of variables

Codes	Full names
Eg	GDP growth
Pse	public spending on education per GDP
Dcp	credit to the private sector
Inf	inflation
Edebt	external debt per GDP
Ddebt	domestic debt per GDP
Lfr	labour force rate
Bm	broad money growth
Pol	political period
Ficap	fixed capital expenditure
Le	life expectancy
Pss	progression to secondary school
Popden	population density
Tel	telephone per 100 people
CuTax	customs tax rates
Mtrade	merchandise trade (% of GDP)
Pta	tax on profit
Cpd	total agriculture production per GDP
Mcap	market capitalisation of listed companies per GDP
Cacc	current account balance
nNtres	total natural resources rent (% of GDP)
Exgdp	Export per GDP

Table A2: Correlation matrix of variables

	eg	ppse	inf	Llfr	bBm	pPol	pPss	pPoden	tTel	cCutax	pPta	cCpd
eg	1											
ppse	-0.458	1										
inf	-0.1951	0.7508	1									
lLfr	-0.3706	0.7878	0.5861	1								
bBm	0.0061	-0.1197	-0.1464	-0.1085	1							
pPol	-0.1494	0.5088	0.865	0.4946	-0.0441	1						
pPss	0.0688	-0.0311	-0.1924	-0.1753	0.0455	-0.277	1					
pPoden	0.0246	0.6794	0.9319	0.573	-0.0358	0.8564	-0.1939	1				
tTel	-0.1134	0.5357	0.8277	0.5239	-0.225	0.6702	-0.2551	0.7268	1			
cCutax	0.0081	0.09	-0.2055	-0.0846	-0.018	-0.1582	0.1206	-0.1266	-0.523	1		
pPta	-0.0071	-0.1701	-0.5923	-0.2047	-0.105	-0.7287	0.261	-0.718	-0.4267	0.238	1	
cCpd	0.0232	0.7058	0.959	0.6342	-0.153	0.8437	-0.1904	0.9584	0.7966	-0.1754	-0.5691	1
mMcap	0.5468	-0.2105	-0.0285	-0.1246	-0.0286	0.0983	0.0752	-0.0004	0.0261	-0.414	-0.1326	-0.0202
dDcp	-0.2127	0.6781	0.869	0.6191	-0.2907	0.7046	-0.2609	0.729	0.8379	-0.2273	-0.3512	0.8442
fFxcap	-0.0435	0.3717	0.7865	0.4064	-0.155	0.8592	-0.202	0.7758	0.6377	-0.2655	-0.7593	0.7789
lLe	-0.2469	0.7802	0.9081	0.6113	0.0168	0.8284	-0.139	0.9442	0.6468	-0.0369	-0.7032	0.867
eEdebt	0.1476	-0.2777	0.2132	-0.0432	0.2203	0.4802	-0.3765	0.3441	0.1899	-0.3193	-0.8247	0.2215
dDdebt	-0.113	0.481	0.6067	0.4571	-0.0427	0.5479	-0.0703	0.6501	0.5005	-0.3319	-0.5575	0.594
mMtrade	-0.2507	0.3157	0.5451	0.4829	0.0958	0.6629	-0.358	0.4812	0.5773	-0.4135	-0.4605	0.5036
cCac	0.1753	-0.6933	-0.946	-0.5542	0.0268	-0.8973	0.2036	-0.969	-0.7185	0.1208	0.7672	-0.9101
nNtres	-0.5945	0.848	0.6387	0.7921	-0.0575	0.5541	-0.1424	0.5679	0.4711	-0.0252	-0.2618	0.565
Exdgp	-0.2305	0.424	0.7772	0.5435	-0.1314	0.7946	-0.3664	0.6972	0.741	-0.392	-0.6698	0.7408

Table A2 continues

	mMcap	dDcp	fFxcap	lLe	eEdebt	dDdebt	mMtrade	cCac	nNtres	Exdgp
mMcap	1									
dDcp	-0.059	1								
fFxcap	0.172	0.7057	1							
lLe	-0.0624	0.6591	0.7149	1						
eEdebt	0.2277	0.0923	0.5801	0.2734	1					
dDdebt	0.2913	0.344	0.5369	0.6853	0.2539	1				
mMtrade	0.1049	0.5588	0.6093	0.468	0.4741	0.3384	1			
cCac	0.0073	-0.7316	-0.8047	-0.9751	-0.3847	-0.6378	-0.521	1		
nNtres	-0.0647	0.5282	0.417	0.7237	-0.0301	0.5605	0.5333	-0.6312	1	
eExdgp	0.0983	0.7879	0.855	0.6451	0.5699	0.43	0.7273	-0.7489	0.5084	1

Table A3: Summary statistics of determinants of economic growth 1970-2012

Codes	Full names	Mean	Stddev	Min	max
Eg	GDP growth	0.011529	0.162098	-1	0.1423
Pse	public spending on education per GDP	2.887447	3.003013	0.64909	12.29017
Cac	current account balance per GDP	5.514459	1.022931	3.91225	6.95
Dcp	credit to the private sector	7.911425	4.813268	1.542269	15.88198
Inf	inflation	39.51758	7.29844	9	126
Edebt	external debt per GDP	55.0735	31.52758	0.004925	0.19701
Ddebt	domestic debt per GDP	0.090331	0.044348	40.5313	139.4303
Lfr	labour force rate	3.397675	1.30177	1.71766	7.4042
Bm	broad money growth	37.11496	14.26822	9.95186	68.52987
Pol	political period	0.4888	0.505	0	1
Ficap	fixed capital expenditure	15.25079	7.2011	3.53148	29.00214
Le	life expectancy	56.56	4.3	48.90	64.3
PSS	progression to secondary school	51.630	2.38036	52.0865	61
Popden	population density	67.74807	21.26984	37.783	109.08
Exgdp	export per GDP	23.07542	11.79702	3.338307	48.80226
TEL	telephone per 100 people	0.6666	0.450012	0.2695	1.667
CuTax	customs tax rates	22.12082	2.77104	15.3962	28.742
Pta	tax on profit	8.1479	2.469864	4.5175	12.25
Cpd	total agriculture production per GDP	59.714807	31.28839	25.44	128.12
Dcp	domestic credit to private sector per GDP	7.93090	4.845477	1.542269	16.116
Mcap	market capitalisation of listed companies per GDP	13.76952	6.0454	1.150969	34.334
NtRESS	total natural resource rents (% of GDP)	4.94	2.76	1.82	16

Table A4. DF-GLS unit root test of the variables used in the BMA analysis

codes	Full names	statistics
Eg	GDP growth	-2.234***
Pse	public spending on education per GDP	-9.339***
Cac	current account balance per GDP	-5.374***
Dcp	credit to the private sector	-2.015***
Inf	inflation	-7.855***
Edebt	external debt per GDP	-4.981***
Ddebt	domestic debt per GDP	-2.048***
Lfr	labour force rate	-5.669***
Bm	broad money growth	-8.599***
Pol	political period	-1.976***
Ficap	fixed capital expenditure	-6.152***
Le	life expectancy	-3.354***
PSS	progression to secondary school	-6.277***
Popden	population density	-2.401***
Exgdp	export per GDP	-4.905***
TEL	telephone per 100 people	-2.165***
CuTax	customs tax rates	-3.062***
Pta	tax on profit	6.278**
Cpd	total agriculture production per GDP	-2.721***
Dcp	domestic credit to private sector per GDP	-2.015***
Mcap	market capitalisation of listed companies per GDP	-4.105***
NtRESS	total natural resources rent (% of GDP)	5.191***

*** and ** denote rejection of the null hypothesis of unit root at 1% and 5% levels, respectively

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